

WHAT IS CLAIMED IS:

1           1. A method for coupling an organomagnesium compound of the  
2 formula:  $R^1MgX^1$  with an aromatic ether compound of the formula:  $Ar^1-OR^2$  to produce a  
3 coupled aromatic compound of the formula:  $Ar^1-R^1$ , said method comprising admixing the  
4 organomagnesium compound with the aromatic ether compound in the presence of a nickel  
5 catalyst comprising a phosphino-ligand of the formula  $PR^3R^4R^5$  under conditions sufficient to  
6 produce the coupled aromatic compound, wherein

7            $R^1$  is selected from the group consisting of aryl and heteroaryl;

8            $R^2$  is selected from the group consisting of alkyl, heteroalkyl, cycloalkyl, aryl,  
9           aralkyl and a moiety of the formula  $-SiR^9R^{10}R^{11}$ , wherein each of  $R^9$ ,  
10           $R^{10}$  and  $R^{11}$  is independently a hydrocarbon moiety;

11           $Ar^1$  is aryl or heteroaryl;

12           $X^1$  is a magnesium metal ligand;

13          each of  $R^3$  and  $R^4$  is independently a saturated hydrocarbon moiety having  
14           from one to about twelve carbon atoms; and

15           $R^5$  is selected from the group consisting of a saturated hydrocarbon moiety  
16           having from one to about twelve carbon atoms and an aryl moiety  
17           having from six to fourteen carbon ring atoms.

1           2. The method of Claim 1, wherein the saturated hydrocarbon moiety is  
2 selected from the group consisting of  $C_1-C_{12}$  alkyl and  $C_3-C_{10}$  cycloalkyl.

1           3. The method of Claim 2, wherein each of  $R^3$  and  $R^4$  is independently  
2 selected from the group consisting of isopropyl, methyl, tert-butyl, iso-butyl, neopentyl and  
3 cyclohexyl.

1           4. The method of Claim 3, wherein  $R^5$  is selected from the group  
2 consisting of isopropyl, methyl, tert-butyl, iso-butyl, neopentyl, cyclohexyl and phenyl.

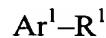
1           5. The method of Claim 4, wherein each of the phosphino-ligand is  
2 independently selected from the group consisting of triisopropylphosphine,  
3 dicyclohexylphenylphosphine, di-tert-butylmethylphosphine, triisobutylphosphine, tri-  
4 neopenylphosphine and tricyclohexylphosphine.

1           6. The method of Claim 1, wherein  $Ar^1$  is aryl.

- 1                   7.     The method of Claim 6, wherein Ar<sup>1</sup> is optionally substituted phenyl.
- 1                   8.     The method of Claim 7, wherein R<sup>2</sup> is methyl or ethyl.
- 1                   9.     The method of Claim 8, wherein R<sup>1</sup> is aryl.
- 1                   10.    The method of Claim 9, wherein R<sup>1</sup> is optionally substituted phenyl.
- 1                   11.    The method of Claim 1, wherein the admixture further comprises at least about 2 equivalents of phosphine compound relative to the amount of the nickel catalyst, wherein the phosphine compound is of the formula: PR<sup>3</sup>R<sup>4</sup>R<sup>5</sup>, wherein R<sup>3</sup>, R<sup>4</sup> and R<sup>5</sup> are as defined in Claim 1.

1                   12.    The method of Claim 1 further comprising admixing the  
2     organomagnesium compound with the aromatic ether compound in a non-aromatic reaction  
3     solvent.

1                   13.    A process for producing a substituted aromatic compound of the  
2     formula:



3     said process comprising admixing an organomagnesium compound of the formula: R<sup>1</sup>MgX<sup>1</sup>  
4     and an aromatic ether compound of the formula: Ar<sup>1</sup>-OR<sup>2</sup> in a non-aromatic solvent in the  
5     presence of a nickel catalyst comprising a phosphino-ligand to produce the substituted  
6     aromatic compound, wherein

7                   R<sup>1</sup> is selected from the group consisting of aryl and heteroaryl;

8                   R<sup>2</sup> is selected from the group consisting of alkyl, heteroalkyl, cycloalkyl, aryl,  
9                   aralkyl and a moiety of the formula -SiR<sup>9</sup>R<sup>10</sup>R<sup>11</sup>, wherein each of R<sup>9</sup>,  
10                  R<sup>10</sup> and R<sup>11</sup> is independently a hydrocarbon moiety;

11                  Ar<sup>1</sup> is aryl or heteroaryl; and

12                  X<sup>1</sup> is a magnesium metal ligand.

1                   14.    The process of Claim 13, wherein the phosphino-ligand comprises a  
2     plurality of saturated hydrocarbons.

1                   15.    The process of Claim 14, wherein the phosphino-ligand is of the  
2     formula:

$$PR^3R^4R^5,$$

wherein

each of R<sup>3</sup> and R<sup>4</sup> is independently a saturated hydrocarbon moiety having from one to about twelve carbon atoms; and

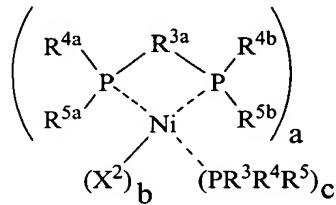
$R^5$  is selected from the group consisting of a saturated hydrocarbon moiety having from one to about twelve carbon atoms and an aryl moiety having from six to fourteen carbon ring atoms.

16. The process of Claim 14, wherein each saturated hydrocarbon is independently selected from the group consisting of C<sub>1</sub>-C<sub>12</sub> alkyl and C<sub>3</sub>-C<sub>10</sub> cycloalkyl.

17. The method of Claim 13, wherein the non-aromatic solvent is selected from consisting of THF, DME, 1,4-dioxane, THP, MTBE, diethyl ether, methyl amine, t-AmOMe, diisopropyl ether, DEM, di-n-butyl ether, and a mixture of two or more solvents thereof.

18. The method of Claim 17, wherein the non-aromatic solvent is selected from the group consisting of t-AmOMe, diisopropyl ether, DEM, di-n-butyl ether, and a combination of two or more solvents thereof.

19. A catalyst composition comprising one equivalent of a nickel catalyst of the formula:



and at least two equivalents of a phosphine compound of the formula:

$\text{PR}^3\text{R}^4\text{R}^5$ ,  $(\text{R}^{4a})(\text{R}^{5a})\text{P}-\text{R}^{3a}-\text{P}(\text{R}^{4b})(\text{R}^{5b})$  or a mixture thereof,

wherein

each of  $a$  and  $b$  is independently an integer from 0 to 2;

c is an integer from 0 to 4;

provided that the sum of  $a+b+c$  is such that the total nickel metal coordination number is 2 or 4;

each  $X^2$  is independently a co-ligand;

$R^{3a}$  is alkylene;

13           each of R<sup>3</sup>, R<sup>4</sup>, R<sup>4a</sup> and R<sup>4b</sup> is independently a saturated hydrocarbon moiety  
14           having from one to about twelve carbon atoms; and  
15           each of R<sup>5</sup>, R<sup>5a</sup> and R<sup>5b</sup> is selected from a saturated hydrocarbon moiety  
16           having from one to about twelve carbon atoms and an aryl moiety  
17           having from six to fourteen carbon ring atoms.

1           20.     The catalyst composition of Claim 19, wherein the nickel catalyst is of  
2       the formula:



3       wherein  
4           each X<sup>2</sup> is independently a co-ligand;  
5           R<sup>6</sup> is cycloalkyl; and  
6           each of R<sup>7</sup> and R<sup>8</sup> is independently selected from the group consisting of a  
7           saturated hydrocarbon moiety having from one to about twelve carbon  
8           atoms and an aryl moiety having from six to fourteen carbon atoms.

1           21.     The catalyst composition of Claim 20, wherein the phosphine  
2       compound is of the formula:



3       wherein  
4           R<sup>6</sup> is cycloalkyl; and  
5           each of R<sup>7</sup> and R<sup>8</sup> is independently selected from the group consisting of a  
6           saturated hydrocarbon moiety having from one to about twelve carbon  
7           atoms and an aryl moiety having from six to fourteen carbon atoms.

1           22.     The catalyst composition of Claim 21, wherein each of R<sup>7</sup> and R<sup>8</sup> is  
2       independently a saturated hydrocarbon moiety having from one to about twelve carbon  
3       atoms.

1           23.     The catalyst composition of Claim 22, wherein each saturated  
2       hydrocarbon is independently selected from the group consisting of C<sub>1</sub>-C<sub>12</sub> alkyl and C<sub>3</sub>-C<sub>10</sub>  
3       cycloalkyl.

1           24.     The catalyst composition of Claim 23, wherein each of R<sup>7</sup> and R<sup>8</sup> is  
2       independently C<sub>3</sub>-C<sub>10</sub> cycloalkyl.

1                   25. The catalyst composition of Claim 24, wherein each of the co-ligand is  
2 independently selected from the group consisting of halide, carboxylate, sulfonate, and 1,3-  
3 diketone.

1                   26. The catalyst composition of Claim 25, wherein each of the co-ligand is  
2 independently halide.

1                   27. The catalyst composition of Claim 26, wherein R<sup>6</sup>, R<sup>7</sup> and R<sup>8</sup> are  
2 cyclohexyl and X<sup>2</sup> is chloride.